was so necessary for root survival and also that its extreme dryness caused roots to die from dehydration.

It was not until 1972 that the scientific answer to the question of gas damage was established and reported in a paper in *Soil Science*, Volume 113, pages 46-54. In that paper "Changes in Composition in Soil Air Near Leaks in Natural Gas Mains" by J. Hoeks, the reason was presented. The paper begins "During the last four or five years because of its disastrous influence on plantations in towns and villages, leakage of natural gas from underground mains has become a real problem in the Netherlands and also in other Western European Countries." The paper then goes on to describe the experiments:

Natural gas containing approximately 82% methane, 14% nitrogen, 1% carbon dioxide and minor quantities of other hydrocarbons, was released in the "normal soils." The normal soil had an oxygen content of approximately 18%, and 3% carbon dioxide.

After a period of gas release (varying number of weeks, pressures and temperatures), the oxygen concentration became extremely low, almost zero percent, and the carbon dioxide rose to up to 15%. The extremely low oxygen concentration is regarded as the most important cause of death of the trees.

The low oxygen content may be caused in part by the displacement of the soil air by the leaking gas, but much more so by intensive oxygen consumption as a result of methane oxidation. Methane consuming bacteria multiply in methane contaminated soil using up the oxygen and giving off carbon dioxide.

The microbiologic investigation proved that the oxidation of methane is brought about by methane consuming bacteria and the oxygen is depleted during the process. In a normal soil in which there is no natural gas, there are few or no methane consuming bacteria. Therefore, just after the start of a gas leak the rate of oxidation of the methane is slow. However, after a period of time the methane utilizing bacteria increase and in turn the concentration of oxygen in the soil will decrease.

As stated by Heath in 1958, and accepted by many observers during the interim when natural gas has pretty much displaced manufactured gas, trees and other vegetation did die in the vicinity of gas leaks in soil even though the scientific reasons were not known.

The results described by Hoeks in his recent paper now give us the scientific answers to the question, "Why do plants die as a result of leaks of natural gas in soil?"

Department of Plant Pathology
Cook College-Rutgers University
New Brunswick, N.J.

TREE PRESERVATION EDUCATION FOR BUILDERS AND DEVELOPERS IN CHARLOTTE, NORTH CAROLINA

by Donald B. McSween, John M. McNeary, and F. Philip Neumann[1]

Abstract. In order to protect Charlotte's trees, we areattempting to educate builders, developers, and public agencies about tree values, physiology, protection, and planting. We feel that such education backed up by practical regulation will in the long run result in more real gains with less restriction on individual freedom.

Charlotte, as most other cities and towns in the country,isfacedwiththeseeminglyopposing problems of growth and natural environment preservation. Many communities have in recent years gone the route of regulation to achieve a balance between the two. We in Charlotte, on the other hand, have had a growing commitment to the concept of education backed up by reasonable and practical regulation. We feel that in the long run education will make more real gains with less restriction on individua freedom.

As a first step in this direction, the Charlotte Tree Commission appointed a committee consisting of the three authors of this paper to

[1] Assistant Extension Agent, Urban Forestry, Mecklenburg County, Agricultural Extension Service, North Carolina State University at Raleigh; President of McNeary's Arborists, Inc., Charlotte, North Carolina and City Arborist, Landscaping/Cemeteries Division, Department of Public Works, Charlotte, North Carolina, respectively.

develop an introductory course in tree protection for builders and developers in the Charlotte area. This course was to be available to any interested parties, and the response so far to the program has been very gratifying. As an outgrowth of the program, we are currently working with one of the largest builders in Charlotte to apply the principles on a subdivision under construction. Besides providing help in the field to the builders, we just have commenced work on an expanded version of the program to provide more detailed information to others who are interested.

The program, a three-hour slide presentation, is given to those who actually do the work in the field. It is divided into five sections for the private sector and six for governmental organizations. The first five sections deal with tree value, tree physiology, types of and practical means of preventing and correcting construction damage, types of trees to be removed during construction activity, and tree planting. For the public sector, a section on damage to publicly owned trees and its prevention or reduction is added.

We attempt to get our message across by repetition of concepts at appropriate times during the course of the program. This has seemed to work quite well and ties isolated points together, making sense of why something is done the way it is, e.g. the need for barricades in the damage-prevention section is referenced to the extent and importance of the root system which was covered in the tree physiology section.

Let us now examine some of the more detailed information that is included in our slide presentation so that the reader may obtain a better understanding of what we are trying to convey to the builder's personnel.

Tree Value

Trees have value for aesthetics, shade, noise reduction, control of wind and water erosion, reduction of air pollution, defining space, screening objectionable views, providing privacy and other benefits. Trees also add monetary value to real estate. Although trees are not without problems, their presence usually results in quicker and higher priced sales for real property. We give an example of a large white oak in front of a local bank buiding and use a tree evaluation formula to demonstrate the value added to the property by that tree. We also show the visual impact trees make on basically the same type of house without trees. Lastly, we discuss the potential for energy conservation in heating and cooling created by having trees around a building.

Tree physiology

Under this section we diagrammatically show the functions of tree roots (feeder and the supporting and conducting ones), xylem, phloem, cambium, and leaves, plus the extent of tree roots, and the movement of nutrients, water, and manufactured food materials.

This is followed by a discussion of a soil profile and its relation to rooting habits. We note how changes in environment, from natural to landscaped conditions, as well as soil compaction affect the growth and functioning of trees. Also, at this point we emphasize how destroying large roots really destroys many miles of feeding roots which are necessary to the continued health of the trees.

Preventing andcorrecting construction damage

This section, the longest one of the program, is reallyapotpourrioftypesofdamage,their prevention and correction. Although damage to trunk and limbs is covered, major emphasis is placed on root damage and how to prevent it.

First, we talk about how to and how not to prune broken, dead or interfering limbs. We show the proper types of tools and the proper technique to be utilized. The reasons for the recommended procedure is explained in terms of the tree physiology that has already been covered.

The second item of business is bark damage and its ultimate result, and if not treated, rotten cavities. Again, proper tools, techniques, and physiological reasons are emphasized.

Root damage, its consequences, prevention, and reduction, is the next and the most important part of the whole program. We begin with a review of root distribution and extent which is followed by explaining how certain construction activities intrude upon that root system. This type of information is intermixed with showing how proper barricading can protect the root systems and thus the trees, both singly and in groups. We also point out how retaining walls, when properly built, may save trees that would otherwise be lost to grade changes.

Another aspect of the root damage problem that builders tend to overlook is the damage underground which appears to be solved when backfilling is completed, e.g. construction of storm drains, curbing, sewer lines, watermains, etc. The ultimate consequence of this type of work, particularly in the Charlotte area, is the invasion of the untreated root system by root-rotting fungi, especially the *Polyporus* group. Once this happens, there isn't much hope of saving a tree.

Another critical issue we cover in regard to roots is the matter of filling over them. We illustrate how to install an adequate drainage system prior to filling so the trees can have a good chance of surviving the construction.

The compaction of soil over tree roots is our next concern. We not only talk about the compaction caused by heavy equipment and material storage but also discuss the effect of pH alteration which may result from such things as discarding concrete next to a tree.

As a final subject in this section, we stress the need for tree fertilization following construction activity in order to stimulate feeder root production for overcoming some of the damage.

Tree removal during construction

An unusual aspect of our program is the stressing of poor tree risk removals prior to construction. Trees in poor health and/or condition are examples. The major emphasis, however, is on the removal of certain species, which, when in weakened condition, are very prone to attacks by pests and diseases that are difficult to control. The two species groups in our area that fit this description are the hard pines (Southern pine beetle) and elms (Dutch elm disease). Recognition of these problems is covered as well.

Tree planting

The important procedures involved in successful tree planting are discussed to encourage the planting of more desirable species on the new home sites. Presently, silver maple is the most popular tree to plant for the builders. We give reasons for not planting it, besides covering a number of species and varieties that do well in our area. We also try to point out how to avoid some of the pitfalls involved in the actual planting techniques and the species selection for the sites involved.

Damage to streettrees

In this last unit, primarily for the public sector, we show what happens if care is not taken in working around street trees, such things as using backhoes up against tree trunks and severe root cutting for curb and sidewalk replacement. All of these items lead to basal and/or root rot with the subsequent premature loss of the trees. The end result is often property damage or even loss of life.

In conclusion, we in Charlotte feel that the most positive way to regulate tree problems, both public and private, is first by education, and second, by reasonable and practical regulation. Our ultimate goal is to have all who work around trees to be aware of their value to our City and how to exercise proper care in preserving them.

ABSTRACT

Knoop, William. 1976. **Why a fertilizer burns.** Weeds, Trees, and Turf 15(11): 14.

One of the characteristics of soluble nitrogen fertilizers is their increased tendency to "burn" turf grasses. The risk of burn may be minimized if the factors that contribute to a burn are understood. Fertilizers contain salts. These salts are not unlike table salt except that they contain various plant nutrients. When a salt is added to water the osmotic pressure of the solution is increased. The increase in the osmotic pressure of the soil solution associated with the application of a fertilizer may determine whether the plant will survive or will die from a fertilizer burn. An understanding of the potential salt effect of the various fertilizer materials can help prevent possible fertilizer burn.